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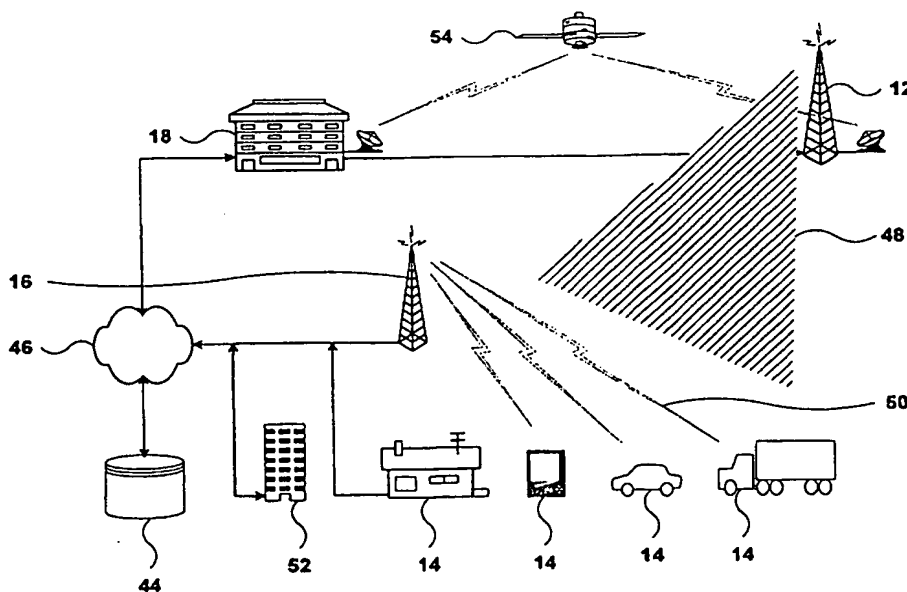
US

(71)(72) Applicant and Inventor: ANGLIN, Richard, Jr. [US/US];  
2115 Heather Lane, Del Mar, CA 92014 (US).(74) Agent: GIACCHERINI, Thomas, N.; Anglin & Giaccherini,  
P.O. Box 1146, Carmel Valley, CA 93924 (US).

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(54) Title: INTERACTIVE DIGITAL DATA BROADCASTING SYSTEM



## (57) Abstract

All existing two-way mobile communications technologies are narrow-band, fixed bandwidth and symmetrical, that is, out-bound and in-bound channel are of size equal. The invention is asymmetrical, the out-bound transmission to the mobile user is much higher in bandwidth than the in-bound channel. Further the out-bound bandwidth is variable; it can be tailored to meet service requirements. The invention comprises a plurality of digital data broadcasting transmitter systems (12) which operate in the frequency bands 2,310–2,320 and 2,345–2,360 MHz (S-band). The invention also includes user terminals (14) which are capable of receiving a plurality of S-band channels, and capable of transmitting in one or more traditional wireless communications bands.

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## Interactive Digital Data Broadcasting System

### TECHNICAL FIELD

The present invention relates to the field of mobile data broadcasting and communications. More particularly, this invention provides novel methods and apparatus for broadcasting digital data including digital audio programming to mobile, portable and fixed receivers and for receiving digital transmissions from those user terminals. Utilization of the present invention will create new markets for interactive audio and data services as well as image and compressed video both on a subscription and advertiser-supported basis.

### BACKGROUND ART

In the United States, several organizations are developing technologies to allow digital signals to be simultaneously broadcast within the same frequency band and on the same channel as existing amplitude modulation ("AM") and frequency modulation ("FM") radio stations, that is, in-band, on-channel ("IBOC"), and technologies to simultaneously transmit digital signals in the same band but in a non-interfering channel adjacent to a FM channel, that is, in-band, adjacent channel ("IBAC"). This technology, if implemented, would allow existing broadcasters to provide a single channel of compact disk ("CD") quality digital programming within the area they currently serve and without additional frequency allocations. In recent comparative testing these systems did not fare well and must be redesigned. Considerable more development and testing is necessary for these systems even to be considered for deployment. Even then, as with exiting AM and FM, these technologies are single fixed channels without interactive capability.

On April 1, 1997, the Federal Communications Commission ("FCC") auctioned two licenses to provide satellite-based digital audio radio services ("DARS") in the United States. Satellite CD Radio, Inc. ("SCDR") and American Mobile Radio Corporation ("AMRC"), a subsidiary of American Mobile Satellite Corporation ("AMSC"), were the winning bidders for the two available licenses in this service respectively (2,320-2,332.5 MHz and 2,332.5-2,345 MHz). Because these are satellite-based systems only, at least three years is required for either of them to commence service. Depending upon the final design of each system, they may offer multiple channels on a nationwide basis only. These DARS systems will not offer regional or local services. Furthermore, they do not provide interactive capability.

Radio Satellite Corporation ("RadioSat") has developed a patented broadcast, navigation and communication system which could be implemented using only narrowband L-band mobile satellite services ("MSS") available from AMSC in the United States and TMI, Inc. in Canada. The RadioSat mobile terminal is conceptually designed to deliver a few channels of digital audio and interactive data

services, including global positioning system ("GPS") information. RadioSat has been actively pursuing opportunities to implement its services but has had no success in over six years of trying.

A number of both terrestrial and satellite mobile data systems exist, all of which systems are fixed narrow bandwidth and limited capacity. None of these systems offer or are likely to offer audio, image or compressed video services because of both bandwidth and regulatory limitations. Further, these systems are focused on commercial applications only such as fleet management and routing, not entertainment or information services. Examples of such mobile data systems include: Cellular Digital Packet Data ("CDPD"), RAM Mobile Data ("RAM"), Advanced Radio Data Information Service ("ARDIS"), AMSC, TMI, Qualcomm, Inc. OmniTRACS® and the "Big LEO" and "Little LEO" satellite systems.

No system exists today which provides asymmetrical digital data communications services to mobile users. The development of a system that provides high bandwidth data broadcast transmission to mobile users and narrowband transmission from mobile users would contribute an important advancement in the communications industry. Such asymmetrical transmission capability would respond to and support a variety of interactive applications, such as Internet and World Wide Web access and multi-channel interactive audio programming.

#### DISCLOSURE OF THE INVENTION

The present invention encompasses methods and apparatus to enable high bandwidth digital data broadcast transmission to mobile users in conjunction with traditional wireless communications systems such as cellular, Personal Communication Services ("PCS") and Enhanced Specialized Mobile Radio ("ESMR") for communications in-bound from users. The disclosed invention can provide a variety of interactive audio and data services as well as image and compressed video to mobile users. The disclosed invention responds to increasing mobility and demands for real-time information.

A preferred embodiment of the invention comprises three (3) elements: broadcast transmission capacity in the newly allocated and recently auctioned Wireless Communications Service ("WCS") bands, 2,310-2,320 and 2,345-2,360 MHz; user equipment capable of receiving transmissions in these bands that have embedded in them traditional wireless phones, and a network management system ("NMS").

The present invention offers a number of synergies and advantages. First, all existing two-way mobile communications technologies are narrow-band, fixed bandwidth and symmetrical, that is, out-bound and in-bound channels are of equal size. The disclosed invention is asymmetrical, the out-bound transmission to the mobile user is much higher in bandwidth than the in-bound channel. Further, the out-bound bandwidth is variable; it can be tailored to meet service requirements.

Second, in a preferred embodiment by obtaining outbound transmission capacity from WCS licensees, no further license is required from the FCC. Only Part 15 type acceptance of terminal equipment is required. It is envisaged that similar advantages will be obtained under the regulations of other countries around the world.

Third, the disclosed invention enables a variety of audio, data, image and compressed video services primarily to mobile users heretofore unavailable.

Fourth, in a preferred embodiment of the invention, the use of Internet Protocol enables services such as voice, video, image, audio, and data which have previously been provided by narrowband networks. Alternative embodiments of the invention may utilize the following frequency bands: 902 to 928 MHz; 2,400 to 2,483.5 MHz; or 5,725 to 5,825 MHz.

Instead of being transmitted at fixed, compressed data rates, audio channels will continuously be transmitted at optimal data rates to guarantee the desired quality perceived by listeners. A preferred embodiment of the disclosed invention comprises a number of "FM quality" channels of audio programming at 64 kbps as well as several "CD quality" channels at 128 kbps. For example, a classical channel will broadcast a symphony at 128 kbps and news segments at 64 kbps while maintaining the same perceived quality. Different channels will be dynamically multiplexed to benefit from these variable data rates so that at each moment the "best" use is made of the available capacity and throughput.

To enable subscription-based services and multiple listeners per subscription, a preferred embodiment of the disclosed invention utilizes subscriber identity module ("SIM") technology. SIM cards the size of a credit card will contain subscriber characteristics and programming choices and will enable subscribers to listen to their preferred programming regardless of the receiver used.

Progressive Networks, Inc. has deployed RealAudio™, a method of transmitting audio programming via the Internet using Transmission Control Protocol/Internet Protocol ("TCP/IP"). An alternative embodiment of the disclosed invention comprises application of this and similar transmission protocol technologies to the mobile environment.

Among other data services a preferred embodiment of the disclosed invention enables transmission of an Electronic Program Guide ("EPG") to all receivers. This guide provides information on current and forthcoming programming or special events available via the disclosed invention.

Because the present invention integrates data communications with audio broadcasting, the listener can be drawn into an interactive environment. A preferred embodiment of the disclosed invention enables transmission of program selection, composer and other information as an integral part of the audio broadcast. Additionally, in an alternative embodiment of the disclosed invention, if the program is taken from a CD, the listener is able to purchase that CD and have it delivered to his home or office simply by pushing a "button" on the receiver touch-screen. A further alternative embodiment of the disclosed invention, enables the listener to access a database or other works by the same composer and order them as well.

Alternative embodiments of the invention enable a number of interactive information services unrelated to audio programming. For example, the invention maybe used to provide continuous stock and bond quotations selected by the subscriber. Through strategic relationships with stock brokers, a further alternative embodiment of the disclosed invention can even enable trades.

The FCC has mandated that wireless communications systems implement technologies to provide location information to be used by enhanced 911 ("E911") systems in responding to emergency situations. Various technologies are under development that utilize the transmissions from a wireless phone to determine its location. Location information thus determined may also be used to provide a number of value-added data and information services via the disclosed invention. For example, the disclosed invention may be used to provide directory information about restaurants, hotels, attractions and other traveler services specific to the area of the caller upon request.

A further alternative embodiment of the disclosed invention comprises receivers including a screen for the display of images or video. The screen may be used to display maps, weather forecasts or other graphic information. A further alternative embodiment of the disclosed invention comprises a thermal printer for hard copies of transmitted or displayed information.

An appreciation of the other aims and objectives of the present invention and a more complete and comprehensive understanding of this invention may be obtained by studying the following description of a preferred embodiment and by referring to the accompanying drawings.

#### A BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows the elements of the *Interactive Digital Data Broadcasting System*.

Figure 2 shows a functional block diagram of the user terminal.

Figure 3 shows a functional block diagram of the user interface.

Figure 4 shows the overall interactive digital data broadcasting network.

#### BEST MODE FOR CARRYING OUT THE INVENTION

A preferred embodiment of the *Interactive Digital Data Broadcasting System* 10 is shown in Figure 1. This embodiment comprises a plurality of digital data broadcasting transmitter systems 12 operating in the frequency bands 2,310-2,320 and 2,345-2,360 MHz (S-band) in the United States; a user terminal 14 capable of receiving a plurality of channels in the said frequency bands and capable of transmitting in one or more traditional wireless communications bands; a plurality of receiving systems 16 for transmission from a user terminal 14; and a network management center ("NMC") 18.

Figure 2 shows a user terminal 14 which comprises an antenna system 20 capable of receiving multiple channels of broadband data broadcast transmissions in said frequency bands 2,310-2,320 and 2,345-2,360 MHz 22 and transmitting on any traditional wireless communications technology 24; a receiver 26; digital signal processing 28; a user interface 30; a transmitter operating in a traditional wireless communications system band 32; and a software operating system 34 to control the functions of the user terminal 14.

Digital signal processing 28 encompasses de-multiplexing of the received broadcast signal, processing the channels of programming and data, and delivering them to the appropriate port of the user interface 30.

5 A preferred embodiment of the user interface 30 as shown in Figure 3 comprises an audio system 36 for listening to programming, a display 38, a plurality of output ports for the utilization of broadcast data 40, and a plurality input ports 42 for user interactivity.

Preferred embodiments of the display 38 comprise a touch screen liquid crystal display ("LCD"), field-emission display ("FED") or other flat-panel display technology.

10 A more comprehensive understanding of the functioning of a preferred embodiment of the invention may be obtained by examining Figure 4. Digital audio programming is created by programming originators 44 and transmitted to the network management center 18 via traditional public and private networks 46. There the programming is assembled and prepared for transmission.

15 The various channels of digital data are then sent via traditional public and private networks 46 to the plurality of S-band transmitter systems 12 for broadcast to users. A typical broadcast 48 is comprised of a plurality of channels of digital audio along with concomitant data information such as composition, title, composer name, length remaining and the program publisher. While the audio is playing via the audio system 36, concomitant data relating to the audio is displayed on the user interface 30 display 38.

20 If the user wishes to purchase the CD from which the audio selection is taken, he or she touches the appropriate area of the touch-screen display 38. A message is transmitted 50 via a traditional wireless communication system 16 to the network management center 18. In a preferred embodiment, these messages are transmitted using a range which generally extends from 1 KHz to 3 GHz. The network management center 18 then sends the order message via traditional public and private networks 46 to a value-added service provider 52 which fulfills the request and delivers the CD to the user.

25 In an alternative embodiment of the invention, a satellite 54 may be employed to distribute signals to the transmitter 12. Alternative embodiments of the invention may utilize the following frequency bands: 902 to 928 MHz; 2,400 to 2,483.5 MHz; or 5,725 to 5,825 MHz.

#### INDUSTRIAL APPLICABILITY

The present invention will offer enhanced high-bandwidth digital communications to mobile users around the globe.

## CONCLUSION

Although the present invention has been described in detail with reference to one or more preferred embodiments, persons possessing ordinary skill in the art to which this invention pertains will appreciate that various modifications and enhancements may be made without departing from the spirit and scope of the Claims that follow. The various alternatives for an interactive digital data broadcasting system that have been disclosed above are intended to educate the reader about preferred embodiments of the invention, and are not intended to constrain the limits of the invention or the scope of Claims. The List of Reference Characters which follow is intended to provide the reader with a convenient means of identifying elements of the invention in the Specification and Drawings. This list is not intended to delineate or narrow the scope of the Claims.

## LIST OF REFERENCE CHARACTERS

10	<i>Interactive Digital Data Broadcasting System</i>
12	Digital data broadcasting transmitter
14	User terminal
16	Traditional wireless receiving system
18	Network management center
20	User terminal antenna system
22	Antenna for receiving broadcast signals
24	Antenna for transmitting via traditional wireless communications systems
26	Broadcast receiver
28	Digital signal processing
30	User interface
32	Wireless communications system transmitter
34	User terminal software operating system
36	Audio system
38	User terminal display
40	Data output port
42	Data input port
44	Programming originator
46	Traditional public and private networks
48	Broadcast signal
50	Message signal
52	Value-added service provider
54	Satellite



## CLAIMS

What is claimed is:

1. A communications system comprising a digital data broadcasting transmitter (12) operating with a relatively high bandwidth, a user terminal (14) for receiving signals (48) from said transmitter and for transmitting signals (50), and network management means (18) for controlling the flow of signals in the system, characterized in that the signals transmitted by the user terminal (14) have a relatively low bandwidth, in that the user terminal (14) incorporates data input means (38, 42) to enable a user to respond to incoming data from the transmitter (12) and to control the signals (50) transmitted by the user terminal, in that a receiver (16) is provided for receiving the signals (50) transmitted by the user terminal, and in that the receiver (16) is connected directly or indirectly to means (52) for responding to the signals (50) transmitted by the user terminal.
2. A communications system according to claim 1, wherein the signals (48) from said transmitter (12) lie in the frequency bands 2.310 to 2.320 GHz and 2.345 to 2.360 GHz.
3. A communications system according to claim 1 or 2, wherein the signals (50) transmitted by said user terminal (14) lie in frequency bands from 1 KHz to 3 GHz.
4. A communications system according to any preceding claim, wherein the user terminal (14) comprises a user interface device (30) comprising an audio system (36), a display device (38) and data input means (42) for operation by the user.
5. A communications system according to claim 4, wherein the data input means is incorporated in the display device (38) in the form of a touch screen.
6. A communications system according to any preceding claim, wherein the signals (48) from said transmitter include digital audio signals together with concomitant data information.

5 7. A communications system according to claim 6, wherein the concomitant data information identifies an audio item being broadcast and actuation of the data input means (38, 42) causes the transmission of signals (50) which incorporate messages which are routed by the network management means (18) to said responding means (52), said responding means (52) being associated with a service provider which is arranged to subsequently supply a copy of said audio item and/or copies of one or more associated audio, data and/or video items.

8. A communications system according to any preceding claim, wherein the network management means (18) communicates with the transmitter (12) and/or the receiver (16) and/or the responding means (52) by signal lines.

9. A communications system according to any preceding claim, wherein the network management means (18) communicates with at least the transmitter (12) via a satellite (54).

10. A communications system comprising:

a digital data broadcasting transmitter (12); said transmitter (12) operating in the (S-band) frequencies;

5 a user terminal (14) for receiving signals from said transmitter (12); said user terminal (14) also for transmitting signals (50) in frequency bands from 1 KHz to 3 GHz (16);

a receiving system (16) for transmission from a user terminal (14) to a mobile subscriber;

an interactive means (38, 42) for accepting a request for service from a subscriber; and

a network management center (18) for controlling the flow of signals through the network.

11. A communications system as claimed in any preceding claim, in which said transmission from a user terminal (14) is in the frequency bands 2,310-2,320 and 2,345-2,360 MHz.

12. A communications system as claimed in any preceding claim, in which said transmission from a user terminal (14) is in the frequency bands 902 to 928 MHz.

13. A communications system as claimed in any preceding claim, in which said transmission from a user terminal (14) is in the frequency bands 2,400 to 2,483.5 MHz.

14. A communications system as claimed in any preceding claim, in which said transmission from a user terminal (14) is in the frequency bands 5,725 to 5,825 MHz.

15. A communications system as claimed in any preceding claim, in which a satellite (54) is used to distribute signals to said transmitters (12).

16. A communications system according to any preceding claim, wherein the signals (48) from said transmitter (12) use an Internet Protocol (IP).

17. A communications system according to any preceding claim, wherein the signals (48) from said transmitter (12) lie in the frequency bands 2.400 GHz to 2.483.5 GHz.

18. A communications system according to any preceding claim, wherein the signals (48) from said transmitter (12) lie in the frequency bands 5.725 GHz to 5.825 GHz.

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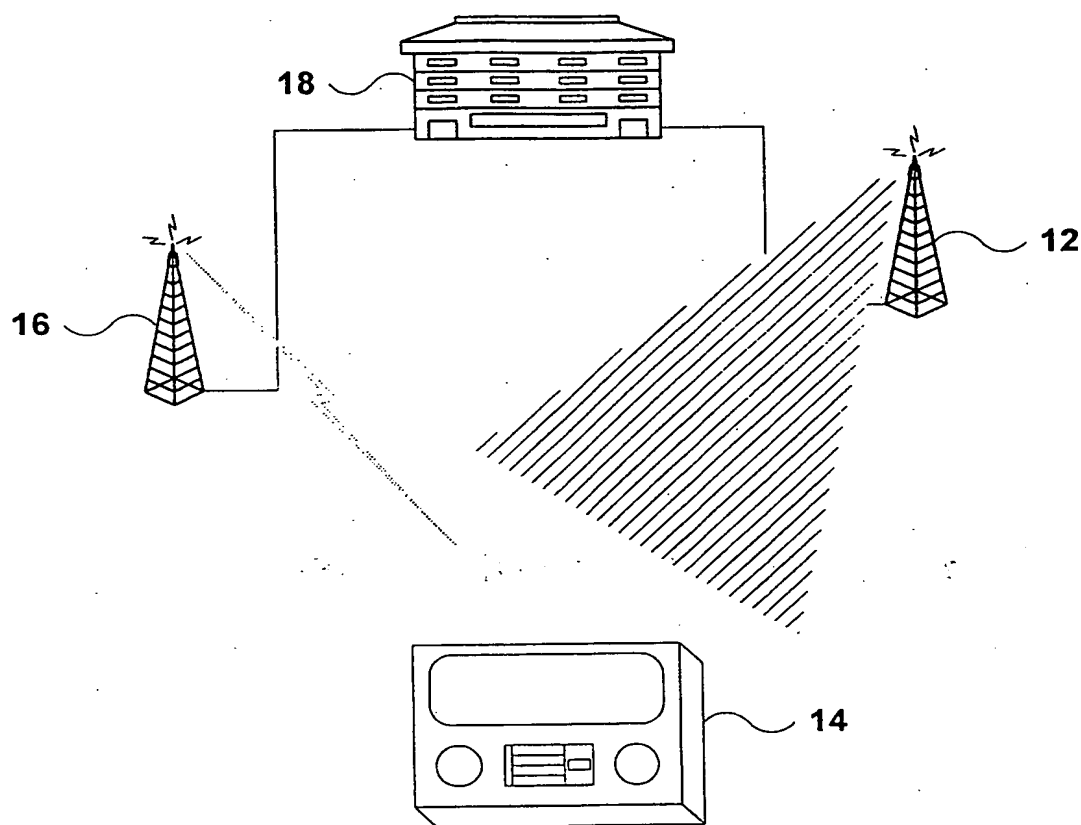
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FIG. 1

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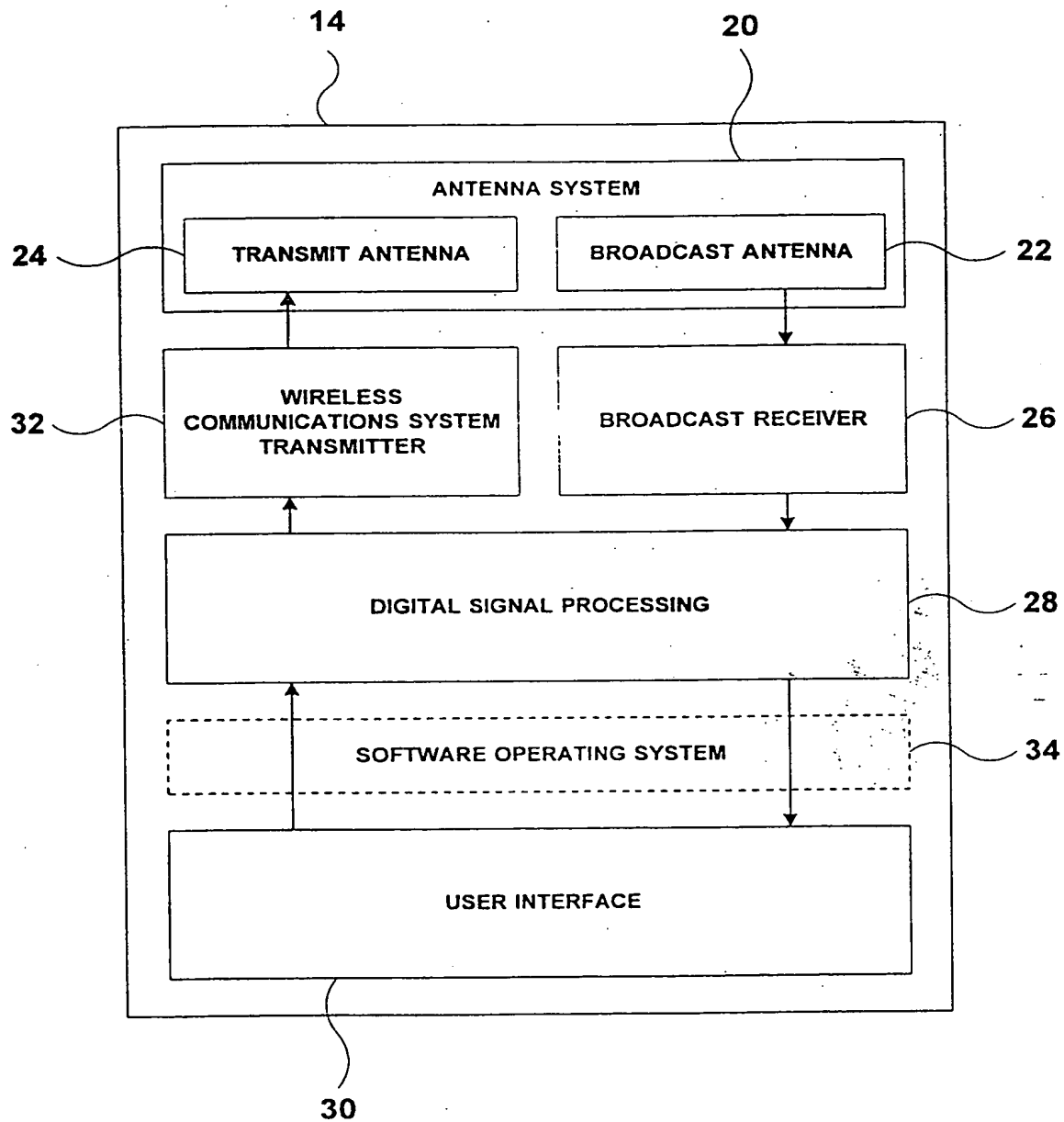


FIG. 2

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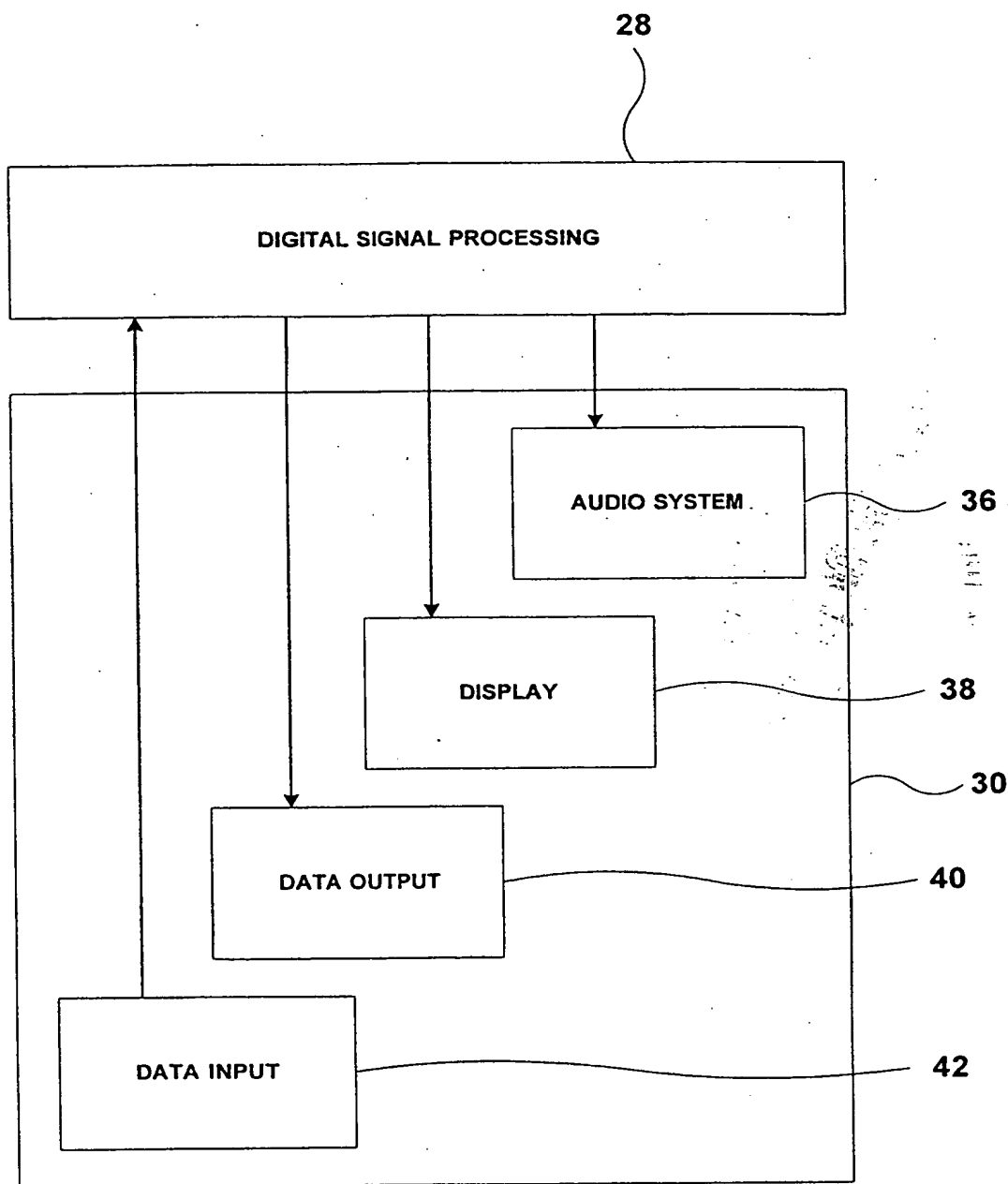


FIG. 3

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